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Towards responsible Digital Transformation: as simple as embracing complexity

ESCP Impact Paper No 2021-03-EN

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Abstract

Through various examples, we show the ambivalence of digital transformation with regard to its impact on sustainable development. We consider more particularly six topics: time, space and the related impact on the psychological state of individuals; memory and the potential conflict with some fundamentals of our society; information privacy; diversity and inclusion; biased decision-making; and environment. In doing so we clarify the articulation of IT and digital transformation within a perspective of sustainable development. We point out that achieving a responsible digital transformation requires a transdisciplinary approach which apprehends the complexity of the system at hand. This paper is an invitation for further work.

Keywords: Information technology, digital transformation, sustainable development, complexity

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Introduction

Two dynamics are driving major changes in organisations and society: digital transformation and the transition to sustainable development. This article focuses on the links between both.

Sustainable development, as defined by the United Nations Organisation in 1987 is a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland Commission (United Nations), 1987).

The following sections tackle briefly how the digital transformation – through IT and the way it is used - impacts the sustainable development, focusing on six topics: time and space, memory, information privacy, diversity and inclusion, biased decision-making, and environment.
For each of them, we stress the coexistence of positive and negative potential impacts and sketch out the main questions and links with other fields.
Then, we clarify why IT is not at the right level when considering sustainable development, whereas the notion of digital transformation is. We argue that working efficiently on a responsible digital transformation requires consideration of it in its full complexity, inviting more transdisciplinary works.

How digital transformation plays with time and space; possible impact on the psychological state of individuals

IT has a direct impact on time and space. In a nutshell, it reduces distances and duration. It also offers new possibilities for temporal parallelism and rapid interlacing of activities. An individual can be in a videoconference, while looking at his/her email, while being in a written conversation via an instant messaging tool with another person. Within the same hour, he can work as if he were in different geographical sites as long as he has access to the files specific to these different sites (see (Meiller, 2018) for a more detailed analysis).
These IT capabilities contribute to a feeling of acceleration of society (Aubert, 2018; Rosa, 2013).
This has positive and negative impacts.
On the positive side - more flexibility, time saved, fast and easy exchange of information are among the advantages.
On the negative side - a blurry border between professional life and personal life, an increase of activity which leaves less and less time for rest, a feeling of urgency and, in professional life, sometimes exhaustion and contributions to cases of burnout.
This ambivalence was salient at the beginning of the covid19 crisis, when a lock down had been imposed in a large part of the world (Meiller, 2020). On the one hand, IT has contributed greatly to the resilience we observed – enabling part of the population to continue working (from home) and to have social relations (via a screen). On the other hand, we observed some people suffering from exhaustion, nervousness and irritability while working from home and finding it more difficult to balance their private and professional lives.

How digital transformation in expanding our memory may conflict with some fundamentals of our society

If the use of IT has brought acceleration, more speed, it has also brought a greater persistence of data.
Data can be stored intentionally. Copies can be stored by third parties. They can also be stored temporarily, at least for technical purposes, without the user being aware of it. Some documents are distributed - and copied - extremely quickly, tens, hundreds of thousands of times, even more.
Computer storage capacities have become gigantic and inexpensive.

The persistence we are talking about is probably going to be reinforced by the Internet of Things, and by a kind of turnaround in the relationship between the subject of memory and the subject who remembers. Indeed, whereas until now humans remembered and their memories were populated by things, the Internet of Things could endow these things with a form of memory - which would be populated by humans who have owned or used the thing. With the digital enrichment of things, much more information about the user, about his behaviour, about his use of the object can be stored in the thing itself.

From this data persistence emerged the question of the right to be forgotten. When one takes an action which is digitally recorded - a post on social media for instance – the trace of this action may be associated with him or her ten years later, twenty years later, or more. The bottom line is that digital memory does not possess the the gradual loss found with human memory. With human memory, in general, some older memories tend to be relatively less clear, less accurate, than more recent memories. Forgetting is natural and partly inevitable.
With digital memory, everything that is recorded is remembered and remains so with the same clarity. When a search engine lists twenty or so links on the first page of the results of a query, the moment when the element was memorised has no impact. At best it will have an impact on the order of the items in the list - if it has been decided to do so. Each item has the same "sharpness", and each item is found with the same ease - regardless of when it was stored. In a way, this is as if these elements - located at different positions in the depth of time - were all projected onto the line of the instant of the query. At the moment of the query, the dimension of time is annihilated. Old or recent digital memories, they are all there, on the same plane.

The issue of the right to be forgotten highlights the complexity of our relationship to the informational world. In 2014, Google organised seven public meetings in Europe involving a group of experts from diverse backgrounds to brainstorm rules for deciding when to grant a right to be forgotten (removing the relevant links) and when to deny it. Our analysis of the transcripts of these exchanges allowed us to list the rights and freedoms invoked during the debates (to justify accepting or refusing the removal of a link). They are gathered in Table 1.
Some of these are rights and freedoms in the legal meaning of these terms, others are not. What is important is that the implications of the right to be forgotten are interwoven into a web of these multiple perspectives.

- Freedom of speech - Freedom of the press - Freedom of communication - Individual right to privacy - Public right to information - Right to denial	- Right to repentance - Right to forgiveness - Right to regret - Right to establish the truth - Right to object - Right to remembrance	- Right to data protection - Internet law - Directive 95/46/EC - Charter of fundamental rights - Defamation - Rights of children and young people

Table 1: Rights and freedoms invoked during public debates about the right to be forgotten

Information privacy is a structural part of social relations and is tightly linked to digital transformation

Privacy is an important value, drawing more and more attention with the development of IT – mainly through information privacy (Pavlou, 2011). Very successful business models rely on valuing personal data (BCG, 2012; Brynjolfsson and Oh, 2012). This trend is expected to grow even more, in particular with the development of Big Data and of the Internet of Things. In return, there is a persistent apprehension among part of the population, uneasy with the idea of being observed, or because of the risk their personal data may be misused. This feeling is reinforced by regular leakage of personal data.
In 2016, the European Union adopted a new legal framework related to information privacy: The General Data Protection Regulation – GDPR. Pushing forward the concept of "Privacy by design", it highlights how important information privacy is for the EU.

Privacy-related discussions can be traced very far in time, back to Aristotle - who conceptualised the distinction between the private and the public spheres of a person. Closer to us – but already more than a century ago, in 1890 – (Warren and Brandeis, 1891) is considered to be a seminal work on a growing concern about the impact on privacy of information-related technologies and methods.
With the rise of digital transformation and the development of the huge business activity based on information processing, privacy – and more specifically information privacy – has attracted much attention from scholars (Bélanger and Crossler, 2011; Pavlou, 2011; Smith et al., 2011).
Despite all this work, "information privacy" and privacy remain fuzzy concepts apprehended in different ways (Ramsay, 2010; Smith et al., 2011; Solove, 2002; Warren and Brandeis, 1891)

Moreover, as we pointed out in the previous section about the right to be forgotten, information privacy has a relation with other constructs. For example, (Smith et al., 2011) shows that privacy concerns are impacted by privacy experiences, privacy awareness, personality differences, demographic differences and culture. They also show that privacy concerns, in turn, impact regulation, behavioural reactions, trust and privacy calculus.
A lot is yet to be done, to better understand information privacy, to tune business models, to reassure people, to better understand their behaviour regarding personal data. Developing personal data business while taking into account the need for privacy and guaranteeing appropriate protection is not a straightforward endeavour.

The role played by digital transformation relative to diversity and inclusion

Digital transformation plays a major role as far as it concerns diversity and inclusion.
It can contribute to the fight against isolation. For example, when a person lives in a remote location, or if he or she is a person with reduced mobility, IT can enable him or her to keep in touch with other people. Here again we are taking advantage of the ability of IT to reduce distances.
On the contrary, the digitisation of services may reduce the autonomy of some people. Consider someone who cannot read or write. This person can go to a desk and explain what he or she is looking for to a human interlocutor. However, once this service becomes fully digital – and the desk is closed – the person needs to know how to use the digital interface to get what he or she needs. Without reading skills, it is very difficult if not impossible.

IT can enable some people with disabilities to access jobs that would otherwise remain inaccessible. Also, many IT-related jobs are well suited to neurodiversity. However, some stereotypes are still attached to IT-related jobs and careers and these are - for example - to the disadvantage of women (Ashcraft et al., 2016).

The digital transformation eases the diffusion of information and has opened wide spaces of interaction, such as the web and social networks. This gives new opportunities to express an opinion which may diverge from the norm. This also gives more opportunities for minorities to be seen. This gives an unprecedented resonance to the reporting of injustice.
Inversely IT has generated new tools for bullying. The recommendation algorithms and automatic filtering on social networks may create sort of bubbles of people alike, eliminating serendipity, contradiction, and exposure to diversity. Digital transformation also pushes a globalisation which may lead to a sort of averaging out and to speeding up the establishment of norms – once again erasing (part of) diversity.
Moreover, the digital transformation has generalised transparency and observation which may place the individual under constant scrutiny and evaluation by others.

Last, the wide-open digital divide excludes the population which cannot get connected from the digital transformation. The disconnection may be due to infrastructure issues, to affordance problems or to a lack of digital skills.

Digital Transformation of Decision-making May Worsen Social and Societal Biases

Digital transformation brings new tools for decision-making. Data analytics, machine learning, Big data, are a few examples of this trend. This allows taking more factors into consideration, and this leads to more data-driven decisions.

This is valuable, but raises questions related to trust. Can one trust the output of a given IT tool?
This kind of question is at the heart of the so-called *transparency of algorithms*.

An algorithm may act as a black box: it receives data as input, and produces a result as output, without the user knowing exactly what is happening between input and output. In this case, how can one be confident in the quality of the result?
There are several risks to consider.
The first risk is that the designer of the algorithm deliberately introduces biases.

A second risk is that the algorithm contains biases that have not been detected, let alone deliberately created. This can happen if the developer makes errors in reasoning when developing the algorithm. It can also happen if a machine-learning algorithm is used with data that is itself biased.

This bias in the data may stem from past discriminatory practices. The algorithm would then reproduce the result of unacceptable practices.
Data can also be biased because of the way they are collected or because of societal changes. If there is an under-representation of certain categories of people and an over-representation of other categories, this under-representation and over-representation could lead to the machine learning to be biased.

Once these biases are “learned” by the machine, they are more difficult to fight against! Indeed, it is then easy to reply - sometimes in good faith - that the accusations are nonsense. In essence, since the decision is made by a computer that has autonomously analysed a set of facts, there can be no racism, homophobia, sexism, or any illegitimate discrimination whatsoever. A computer is just a computer: it has no feeling, it cannot love and it cannot hate.

A variant of this risk is to have bugs in the algorithm, leading to erroneous decisions in some cases – without constituting a clear bias. Even though these errors may be more sporadic, their negative impact on the individuals involved may be strong.

Finally, the algorithm may not be adapted to the specificities of the situation under consideration. This may be a special case, which does not fit well with the various cases anticipated by the designer of the algorithm and which would require additional data to be taken into account. This can be explained and discussed with a human analyst, but not with a computer.

The technical details of the algorithm can contribute to a greater or lesser degree of transparency. In artificial intelligence, there are approaches which allow us to observe the mechanisms of the analysis, which allow the result to be demonstrated. The algorithm therefore produces a result and an argument for this result.
This is not the case with machine learning - or at the very least, it is very difficult to achieve with this type of algorithm.

Environmental impact of digital transformation

Digital transformation – with a particular focus on the use of big data and data science- comes with a promise of optimisation. Here are some examples: optimising the thermal management of a building; optimising the operation of a fleet of lifts; optimising the global electricity network (the smart grid); optimising driving thanks to autonomous cars and for that matter optimising traffic thanks to the control of traffic lights and other routes; optimising purchases in food shops for less waste; optimising the operation of an industrial site, even optimising the design of devices... If the ecological impact is included in these optimisations, the digital transformation is a great contributor to the ecological preservation of the planet.
Today we have the technological means to achieve optimisations that were impossible a few years ago. Of course, the choice of what to optimise is a human question, not a technological one.

In contrast, the use of IT, in itself, has a negative impact on the environment. First, these technologies use physical devices - computers, antennas, processors, cables, screens, etc. Manufacturing them consumes resources. On the one hand, the extraction of some of these resources is harmful to the environment, and on the other hand, the question arises of how limited these resources are.
Is the durability of these devices reasonable? Here, a distinction must be made between a part of the infrastructure (e.g. submarine communication cables) and the terminals such as a personal computer or a smartphone. The latter is frequently replaced. The replacement of these devices is usually not related to a failure. The computer works as well as it did in its prime, but it is no longer powerful enough for newer versions of operating systems and software. This replacement can also be related to an image concern as well as social pressure (more so for smartphones than for computers).
Finally, there is the question of recycling these devices. Are they recyclable? To what extent?

Second, the activity of IT (when running) has a negative impact on the environment. All IT consumes electricity. For several decades now, manufacturers have incorporated efforts to reduce power consumption into their designs. Data centres require temperature and humidity control which lead to extensive use of air conditioning. An alternative is to locate data centres in climatically favourable areas, for example, the far north - where it is naturally cold. Note, however, that this strategy may be contradictory to a sovereign cloud policy - not all countries have a cold geographical area.
Network use and information storage in data centres consume energy. Therefore, the rise of the cloud may have a negative impact on energy consumption... or not.
Consider the example of an email. I want to send an email to 1000 people and include a document. Either the document is joined as an attachment, or the document is in the cloud, on a drive, and I include only the link to it in the email.
At first glance, the attachment seems to be the most energy-intensive solution. Indeed, at the time of sending, the document is copied 1000 times and these 1000 files will transit on the network to their recipients. This will consume much more bandwidth, and therefore energy. If the cloud is preferred, the file is not copied 1000 times. Instead, it is simply the link to the document that will be copied within the 1000 messages.

Now, let us consider the behaviour of the recipients.
Assume that only 5% of the recipients open the attachment. In this case, it was better not to copy the file 1000 times, for only 50 users. By using the cloud, only those 50 people went to see the document in question.
Now, let's assume that 100% of my recipients see the contents of the attachment. In this case, even using the cloud, the file will be copied 1000 times - not when it is sent, but when it is viewed. Indeed, when one uses a web browser to open a file from the cloud, the data about the contents of that file are transmitted to the local computer for viewing.
Worse, in the case of an attachment, the file is received - once - and stored locally. In the case of a file on a cloud drive, some users will click on the link in the email every time they want to view the document... triggering a copy and transmission over the network each time. The number of copies of the file then exceeds 1000.
To get a full assessment of the energy consumption in this example, one would have to also consider the differences in optimising energy consumption between a personal system and a data centre, between architectures distributing the cloud content in different data centres closer to the end users, and of course, the way electricity is generated, etc.
It is also interesting to compare the carbon footprint of this example with a non-digital alternative. What would be the environmental cost of delivering this message and the associated document by conventional means: truck, train, plane, etc.? This raises the question of behaviour induced by the ease of use of digital tools. If we had to use a non-digital alternative, would we have chosen to send 1000 copies?

Choices, Awareness and Complexity

The considerations in the previous sections show how digital transformation is at the same time an outstanding tool in achieving sustainable development goals and a formidable threat jeopardising this very achievement. This tension between positive and negative impacts of digital transformation exists in many dimensions of sustainable development. Fostering the positive outputs and reducing the deterrents is not easy. We do not propose any solution here, but invite preliminary thoughts for discussion as well as opening avenues for research and action.

First, it is important to articulate IT and digital transformation in a perspective of sustainable development. The digital transformation is not about IT only, but about information systems. An information system is made of IT, processes (organisation), and persons (Alter, 2013; Neufeld et al., 2007; Westfall, 2012). IT does not create value. Neither does it destroy value. The way IT is used is what derives value. This is more about organisation and persons than about IT. A tool does not select how it is used! For this reason, talking about "responsible IT" would make no sense. Contributing to sustainable development is a matter of choice. This is at the level of the transformation which is shaped - with the use of IT- at the level of the digital transformation, hence "responsible digital transformation."

Thus, it is interesting to note that digital transformation brings tools with capabilities which may exceed our needs. The negative impact of digital transformation on sustainability is partly due to the implementation and use of this excess. This is not because a tool makes something possible that we should do it. For example, the right to be forgotten is rooted in this scheme. The fact of downloading the same file again and again, because it is so easy to retrieve it from the link received in an email, is in the same line. So is encrypting all data at the highest level of security instead of focusing only on sensitive data. Frugal innovation (Radjou and Prabhu, 2015) may be here an interesting source of inspiration, not for designing systems in a context of lack of means, but to identify whether certain systems in operation could be achieved with fewer resources, so that the solution with the best impact can be chosen.

Finally, responsibility is about the liability and the ability to choose between right and wrong. This is a matter of conscious choice. This requires an awareness which is not easy to have.

Indeed, computer science (at the technical heart of the digital transformation) relies on a pile of abstractions which hide the details of implementation. IT is inherently invisible as much as is possible. The end user is not to be bothered by the technical details. A developer relies on the development of others without needing to know the details of implementation. This structure makes it possible to do more by ignoring the details of the developments on which we rely. This is what makes it possible to build increasingly complex technical systems, while controlling the complexity of the development itself. The power of this approach, as far as it concerns development and creativity, tends to hinder the evaluation of a system in terms of sustainability.

Beyond these inherent characteristics of computer science, we have seen that the relation between digital transformation and sustainable development is made of many connections, between many different fields. Some of them contribute positively to sustainability and some contribute negatively. This interweaving is at the heart of complexity and complex thought (Morin, 1982). The latter is defined as a form of thinking that accepts the interweaving of each field of thought and transdisciplinarity, the term complexity being taken in the sense of its etymology 'complexus', which means 'that which is woven together' in a tangle of interweaving (plexus).

Making choices orienting digital transformation towards sustainable development requires such an approach. To become responsible, digital transformation needs to be considered in its entirety, as a complete complex system, including its connections with the rest of the world. This implies multidisciplinary work and much effort for an exciting perspective!

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